



**Garry Oak
Ecosystems
Recovery Team**

**Stewardship Account for
Rosy Owl-clover
*Orthocarpus bracteosus***

Prepared for the
Garry Oak Ecosystems Recovery Team
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by

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SPECIES INFORMATION

Name and Classification

Scientific Name: *Orthocarpus bracteosus* Benth.

Synonyms: none

Common Name: rosy owl-clover

Family: Scophulariaceae

Major Plant Group: Angiospermae (flowering plants)

In the typical variety of rosy owl-clover plants have rose-purple flowers. Keck (1927) also described variety *albus* in which the flowers are white. Chuang and Heckard (1992) considered this colour variation to have no taxonomic significance, observing that the two colour forms sometimes grow in close proximity. This may not be strong evidence of genetic identity however, since Atsatt (1970) observed that two or more species of *Orthocarpus* often occur on the same site – sometimes separated by microhabitat differences but mostly intermixed as individuals or clusters. This is manifest on Trial Island, where *Orthocarpus bracteosus* contains both colour forms as well as a large intermixed population of *Castilleja ambigua* (formerly *Orthocarpus castillejioides*).

Keck (1927) placed 25 species of annual species in the Castillejinae into the genus *Orthocarpus*. Many of these species have since been re-assigned to *Castilleja* or *Tryphysaria* leaving nine species in *Orthocarpus* as it is now constituted (Chuang and Heckard 1991).

Description

A rose-purple annual herb from an erect stem 10-40 cm tall, slender, simple or branched above. Plant is short-hairy and usually purple-tinged. Leaves are alternate, stalkless, linear to lance-shaped and 1.5-3.5 cm long. Leaves have short spreading hairs and sometimes have gland-tipped hairs. The upper part of each leaf is 3-cleft; the upper leaves in the flower head have wide 3-lobed bracts. Flowers are grouped in a dense, prominently bracted (small leaves), densely hairy and glandular terminal spike 3-15 cm long. The bracts are either all green or are purple-tinged in the upper part. Flowers are rose-purple or occasionally white to cream coloured, hairy, 12-20 mm long, exerted from the bracts and tube-shaped. Sepals are tube-shaped, 6-10 mm long, green and glandular-hairy. Fruit is a capsule, elliptical in shape, 5-7 mm long and contain 8 – 15 seeds about 3 mm long (Douglas *et al.* 2000). Plants of the remaining Canadian population at Trial Island averaged 5 cm tall and reached a maximum of 9 cm in 2001 (pers. obs.). White-flowered plants are not easy to distinguish in vegetative condition but their leaves are less likely to be purplish-tinged so they tend to be paler than foliage of the typical variety (pers. obs.).

Yellow owl-clover (*Orthocarpus luteus*) is the British Columbia species most closely related to rosy owl-clover. Both have glandular-hairy bracts and calyces, and the upper leaves gradually grade into bracts in both species. Yellow owl-clover does not

occur west of the Coast-Cascade Mountains and its golden-yellow flowers cannot be confused with the rose-purple (occasionally white) flowers of rosy paintbrush (Douglas *et al.* 2000).

In the field, rosy owl-clover may be confused with several annuals within the Castillejinae that potentially co-occur with it including: paintbrush owl-clover (*Castilleja ambigua*), narrow-leaved owl-clover (*Castilleja attenuata*), dwarf owl-clover (*Triphysaria pusilla*) and bearded owl-clover (*Triphysaria versicolor* ssp. *versicolor*). Members of *Triphysaria* can be immediately separated when in flower because their anthers are 1-celled and their lower corolla lip is strongly three-pouched. In both *Castilleja* and *Triphysaria* the tips of the beak-like upper corolla lips are open and the stigma is expanded, while *Orthocarpus* has closed tips and a dot-like stigma. *Castilleja ambigua*, *C. attenuata*, and *Triphysaria versicolor* spp. *versicolor* have white or yellow corollas (sometimes with purple markings and/or fading pinkish) in contrast to the rose-purple corollas typical of *O. bracteosus*. The red-purple corollas (4-6 mm) of *Triphysaria pusilla* are much smaller than corollas of *O. bracteosus* (12-20 mm) (Douglas *et al.* 2000).

Figure 1: Illustration of *Orthocarpus bracteosus* Benth. from Douglas *et al.* (2000)



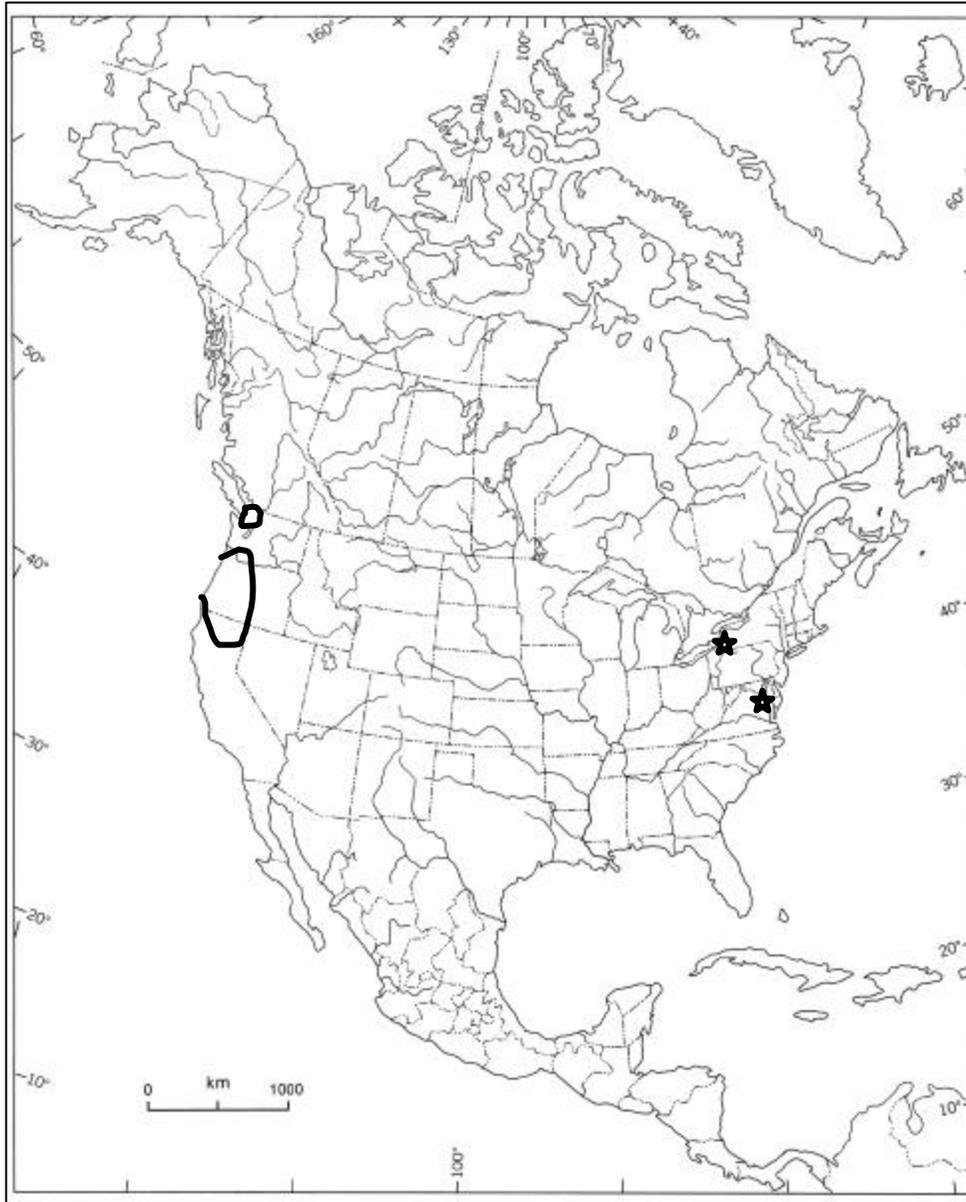
RANGE AND KNOWN DISTRIBUTION

Global Range

Rosy owl-clover occurs in western North America, mainly from Vancouver Island south to Oregon west of the Cascades, and southward east of the Cascades to Plumas County, California (Douglas *et al.* 2000). In Washington, it is only known from Conboy

Lake National Wildlife Reserve and Kreps Lane in Klickitat County (southern Washington) and three historical records from San Juan and Whatcom counties in northwest Washington State (1890, 1923, and 1904) (Florence Caplow, Botanist, Washington Natural Heritage Program, pers. comm. Nov 6, 2001). There have been two recent unconfirmed sightings in northwestern Washington and botanists continue to search for it there (Terry Domico, Conservation Biologist, Puget Sound BioSurvey, pers. comm., Feb 25, 2001).

Figure 2. Global Range of *Orthocarpus bracteosus*



Rosy owl-clover has also been reported for two eastern states, Maryland and New York. The New York collection was from a canal lock in Cayuga County. It was collected in 1918 and was obviously a waif (Charles Sheviak, Curator of Botany, New

York State Museum, pers. comm. Feb. 22, 2001). The Maryland collection also appears to be an introduction (Jim Reveal, Professor Emeritus, University of Maryland, pers. comm. Feb. 20, 2001).

Canadian Range

Currently in British Columbia it is known from 1 extant occurrence and 9 unconfirmed historic localities, all in the Victoria area (BC Conservation Data Centre, February 18, 2002).

Figure 3. Canadian Range of *Orthocarpus bracteosus*



Orthocarpus bracteosus has been known in the Victoria area since 1893. Historical records for Sidney, Oak Bay, Victoria and the Patricia Bay Highway are unmapable because the locality is too vague. Historical records of populations at Rollin's Farm, Blenkinsop (Lost) Lake, Mount Douglas (Cedar Hill) and Beacon Hill are at least 90 years old and no populations have been reported in recent years. They have probably been extirpated. The Elk Lake collection from 1933 may be from the same population as the 1954 collection from the Patricia Bay Highway but it has not been found recently despite detailed searches of the most suitable habitats by the senior author in 2000 and 2001. These searches also covered:

- all of Trial island,
- suitable areas on Discovery Island,
- Mount Douglas
- Beacon Hill Park/Dallas Road Bluffs
- east side of Elk and Beaver Lakes
- Uplands Park/Cattle Point
- Glencoe Cove
- Macaulay Point
- Saxe Point
- Fort Rodd Hill
- Ten Mile Point
- Little Saanich Mountain (Observatory Hill)

The only population known to be extant is that on Trial Island. The author most recently confirmed this site in July 2001.

In conclusion, there has been a consistent downward trend in the number of locations consistent with the urban growth and development of suitable areas on the shore and offshore islets around Victoria. The total extent of the occurrence of rosy owl-clover in Canada has similarly declined and now consists of a patch of approximately 300 m² on Trial Island.

HABITAT

Habitat Requirements

The single population of *Orthocarpus bracteosus* known in Canada occupies a very shallow vernal pool (simply a moist depression during dry winters). Soils are 15-30 cm deep and have a pronounced Ah horizon likely built up through the *in-situ* decomposition of forb and grass roots. The soils are lightly churned in the winter, apparently by gulls pecking at the soil surface. The vegetation lacks trees, shrubs or robust herbs. Plant cover peaks in early summer, at about 20%. The dominant species include *Grindelia integrifolia*, *Plantago lanceolata*, *Hypochaeris radicata*, *Prunella vulgaris* and *Orthocarpus bracteosus*. Less abundant species include *Lotus unifolius* var. *unifolius*, *L. formosissimus*, *Plantago elongata*, *Mimulus guttatus*, *Fragaria chiloensis*, *Armeria maritima*, *Festuca rubra*, *Holcus lanata*, *Vulpia bromoides*, *Geranium molle*, *Isoetes nuttallii*, *Dodecatheon pulchellum*, *Limnanthes macounii* and *Castilleja ambigua*. The last two species are of special importance - COSEWIC has designated *Limnanthes macounii* as a species of Special Concern while *Castilleja ambigua*, known from less than 10 extant sites in British Columbia, is a likely candidate for future listing.

Older records suggest *Orthocarpus bracteosus* formerly occurred sporadically across a variety of open, winter wet/summer dry habitats including ditches, prairies and open fields. This is consistent with habitat descriptions for populations in Washington State (Florence Caplow, Botanist, Washington Natural Heritage Program, pers. comm. Nov. 6, 2001).

Trends

There is no specific information on the trend of shallow-soil meadow habitats in the Victoria area although there is some information on trends in Garry oak systems in general. Three major trends have influenced these habitats over the past century: (1) cultivation, (2) urbanization and (3) invasion by aggressive alien weeds. Overall, these factors have reduced Garry Oak systems to less than 5% of their original extent in the Victoria area. They persist largely as isolated communities that are heavily fragmented and lack connections that would allow substantial genetic interchange (Lea 2002).

The Trial Island habitat is suffering from encroachment by a number of aggressive alien species including Scotch broom (*Cytisus scoparius*), gorse (*Ulex europaeus*), spurge-laurel (*Daphne laureola*), English ivy (*Hedera helix*), Ribwort (*Plantago lanceolata*), hairy cat's-ear (*Hypochaeris radicata*), Yorkshire fog (*Holcus lanata*), barren fescue (*Vulpia bromoides*) and dovesfoot geranium (*Geranium molle*).

Protection/Ownership

The Trial Island site lies on or near the boundary between Trial Island Ecological Reserve and provincial land leased to Seacoast Communications. The Canada Coast Guard owns the Trial Island Lighthouse station near the existing rosy owl-clover population.

Trial Island Ecological Reserve offers nominal protection to all plant species found within its boundaries through the Protected Areas of British Columbia Act, which requires that a valid and subsisting park use permit be acquired before a plant can be destroyed, damaged or disturbed. B.C. Parks does not have any staff stationed on Trial Island and the legal protection afforded ecological reserves is not likely to actually protect the population from major habitat threats. It is unclear whether the occupied habitat lies within, or just outside the ecological reserve.

British Columbia does not have any legislation specifically protecting species at risk.

STATUS OF SPECIES

Populations

There are about ten reported locations for *Orthocarpus bracteosus* in Canada, all in the Victoria area. Only one of these populations, on Trial Island, is known to be extant. The earliest record from Trial Island (1976) did not include an estimate of population size. Population estimates in recent years suggest a rapid buildup from 40 shoots in 1998 to at least 150 shoots in 1999 and 940 ± 20 in 2001. The build up of shoot numbers was not accompanied by an increase in the area of occupancy - even in 2001 the population was still restricted to a small area of about 300 m².

Existing Protection

- *Orthocarpus bracteosus* is not covered under the Convention on International Trade in Endangered Species (CITES), the Endangered Species Act (USA) or the IUCN Red Data Book. Natureserve has designated a G3? rank for the species. The G3 rank indicates that the species is classified as "rare or uncommon (typically 21-100 occurrences); may be susceptible to large-scale disturbances; e.g., may have lost extensive peripheral populations". The '?' indicates that limited information is available or the number of extant occurrences is estimated.
- *Orthocarpus bracteosus* is currently on the B.C. Conservation Data Centre RED LIST, which includes any indigenous species or subspecies (taxa) considered to be Extirpated, Endangered, or Threatened in British Columbia.
- In both British Columbia and Washington, *Orthocarpus bracteosus* is ranked as S1, "critically imperiled, because of extreme rarity or because of some factor(s) making it especially vulnerable to extinction." In California and Oregon the species is ranked SR. This designation is supposed to indicate that the species is "reported for the state, but without persuasive evidence for either accepting or rejecting the report". In fact, Hickman (1993) and Peck (1941) report the species for California and Oregon respectively and neither indicate it is in any way rare. The proper ranking for California and Oregon is probably SU (essentially unranked).
- Federal endangered species legislation has been proposed in Canada. The Trial Island population may be eligible for protection once this legislation is passed, if the species is officially listed as endangered, threatened or of special concern.
- British Columbia does not protect endangered species through legislation. The Trial Island population would be protected by provincial legislation for protected areas, if it actually occurs within the ecological reserve.

LIFE HISTORY

Reproduction

Orthocarpus bracteosus is a true annual, incapable of overwintering in British Columbia. All flowers are chasmogamous and there is no asexual means of reproduction (pers. obs.).

It appears that species of *Orthocarpus* (*sensu lato*) are predominantly outbreeders although there are inbreeding self-compatible taxa such as *Triphysaria pusilla*. The two contrasting breeding systems may partition the host-environment of these parasitic plants with the showy outbreeders forming compact masses in order to improve the efficiency of cross-pollination while the inbreeders are more dispersed (Atsatt 1970). It is uncertain whether *O. bracteosus* is an inbreeder or an outbreeder – the latter seems likely as it does have very showy flowers and at least the Trial Island plants are somewhat clumped.

Survival

As an annual, survival is limited to a single year. There is no information on what portion of the established population survives to flower and set seed. Wide population fluctuations in shoot numbers are typical in many annual species (Harper 1977) but they may not provide an accurate estimate of population trend – particularly if the increase in shoot numbers occurs through seed bank depletion. Atsatt (1970) observed that patterns of abundance and distribution in populations of grassland *Orthocarpus* show sizeable year-to-year fluctuations within sites.

Movements/Dispersal

Seed dispersal is poorly understood although a number of hypotheses have been advanced. Atsatt (1965) proposed a ‘coordinated dispersal’ hypothesis in which *Orthocarpus* seeds get caught up in the pappus bristles of *Hypochaeris* (which often occurs with *Orthocarpus*) and are wind-dispersed as a result. Chuang and Heckard (1983) were skeptical of the coordinated dispersal hypothesis, believing most seeds are not dispersed beyond the immediate vicinity of the parent. Nevertheless, they did speculate that reticulations on the coats of the small, light-weight seeds may improve aerodynamic properties important to wind-dispersal, or add surface roughness aiding in animal dispersal (ibid.). Alternately, the loosely netted reticulations on the seed coat may trap air and thus add bouyancy to seeds during dispersal by water (Kuijt 1969). On October 16, 2001 – long after plants had withered and died – many capsules on Trial Island plants still contained abundant seeds (pers. obs.). They appear to remain on the plant well into winter, rattling out as winter winds shake the capsules like a saltshaker.

Nutrition and Interspecific Interactions

Species of *Orthocarpus* have been found to use a C3 photosynthetic pathway (Watson and Dallwitz 1992 and onwards).

Members of the genus *Orthocarpus* are hemiparasites, containing chlorophyll and fixing carbon through photosynthesis but receiving water and nutrients through parasitic root connections (Kuijt 1969). Closely related species of *Orthocarpus* have been shown to be facultative hemiparasites capable of growing and producing flowers in the absence of a host, but shoot mass tends to be much higher in the presence of a host (Matthies 1997).

Grassland species of *Orthocarpus* form haustorial connections (root grafts) with a number of grassland associates including annuals and perennials of the legume, grass, composite and many other families. Not all plants are equally good hosts - some appear to reduce the reproductive potential of *Orthocarpus*. The parasitic habit is unlikely to be a limiting factor given the diversity of potential hosts intermixed within the Trial Island population.

Many hemiparasites including species of *Orthocarpus* may obtain secondary compounds from their host plants. These can reduce herbivory without affecting pollinators. It appears that alkaloids may be taken up in the leaves and outer floral tissues of some species but not by their nectar, which has the ultimate effect of increasing seed production and improving fitness (Adler 2000, Adler and Wink 2001, Boros, Marshall, Caterino and Stermitz 1991).

Species of *Orthocarpus* (*sensu lato*) may serve as a secondary host for larvae of the Bay Checkerspot (*Euphydryas editha bayensis*) if its primary food source (*Plantago* spp.) withers before the onset of diapause (USEPA 2000). Coincidentally, the closely related *Euphydryas editha taylori* - a provincially and nationally rare butterfly - has also been recorded from Trial Island. Populations of this butterfly present a potential, but minor, herbivory threat to *Orthocarpus bracteosus* although they have not been seen on Trial Island for several years. *Orthocarpus bracteosus* is probably not a significant food source for the butterfly on Trial island because alternative secondary hosts such as *Castilleja levisecta* are much larger and more abundant.

HOW THE SPECIES IS AT RISK

Habitat degradation poses a critical and urgent threat to *Orthocarpus bracteosus* in Canada. The single remaining population occupies an area of less than 300 m² which already contains a number of aggressive alien species including *Plantago lanceolata*, *Hypochaeris radicata*, *Holcus lanata*, *Vulpia bromoides*, *Geranium molle*. In addition, English ivy (*Hedera helix*) has reached the margins of the population and will continue to spread in phalanx fashion across the site as a ground cover. Several introduced shrubs including Scotch broom (*Cytisus scoparius*), gorse (*Ulex europaeus*), spurge-laurel (*Daphne laureola*) also occur in the vicinity of the site and pose a longer-term threat.

The second critical threat to the existing population comes from foot traffic. Trial Island is relatively inaccessible except to Coast Guard staff and recreational boaters from nearby Victoria. Nevertheless, the population is situated in a constriction between two rocky areas and attracts a surprisingly high level of foot traffic.

The Trial Island population is also potentially threatened by marine pollution as it grows only a few metres above the high tide line along one of the most active shipping lanes in North America.

The Trial Island population has little potential for dispersal into suitable habitats. Many waterfront sites on nearby areas of Vancouver Island that were formerly capable of supporting the species have been irreversibly impacted by urbanization. Sites elsewhere on Trial Island and nearby areas of Vancouver island which remain capable of supporting the species, are currently unsuitable due to encroachment by highly competitive, non-native shrubs and grasses.

The very fact that the species is limited to a single, small site in Canada presents a serious limitation because stochastic forces could quickly eliminate the population. There is negligible opportunity for a rescue effect from elsewhere. All other populations in the Victoria area and Puget Sound appear to have been extirpated. The nearest known, extant populations are approximately 300 km away.

MANAGEMENT RECOMMENDATIONS

- *Orthocarpus bracteosus* should be recommended for Endangered status in Canada.
- Population biology studies should be conducted to determine what steps are most limiting in the production and dispersal of seed and establishment of new plants and populations.
- Kayakers and staff from Canada Coast Guard and Seacoast Communications should be informed of the location and sensitivity of the population to disturbance.
- Gorse and Scotch broom should be removed from Trial Island and their control should be monitored annually.
- Seed should be collected and propagated in order to provide a source for re-introduction to extirpated sites and introductions to new, suitable sites.

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